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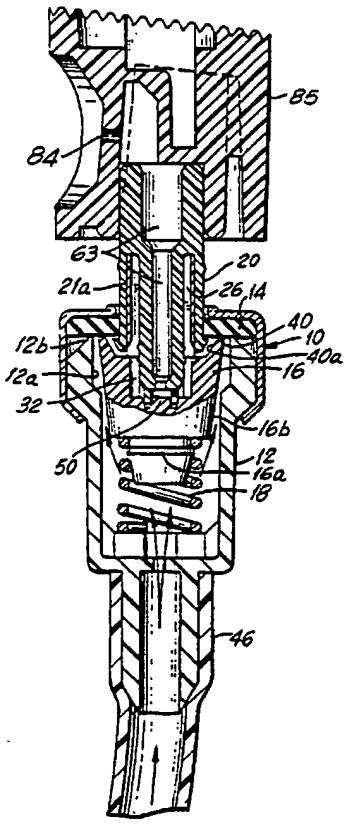
(54) Title: IMPROVED TILT ACTION AEROSOL VALVE

(57) Abstract

In an aerosol valve comprising a mounting cup (10), a gasket (14) having a central opening, a valve housing (12), a valve stem (20) and a valve body (16), where the valve stem (20) and valve body (16) move within the valve housing (12) in response to pressure on the valve stem (20), the valve body (16) has a cylindrical upstanding wall (26) defining a recess. A slot extending through the wall (26) is defined by the wall and a thin skin (21a). The slot (21) communicates with the interior of the container when the valve is actuated. A swirl chamber (68) may be located at the bottom of the valve body (16). The valve can be configured for tilt actuation.



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IMPROVED TILT ACTION AEROSOL VALVE

Background of the Invention

This invention relates to a valve for a pressurized package commonly referred to as an aerosol package.

Aerosol packages usually comprise a valve unit situated in the neck of the container which is opened by finger pressure against an actuator disposed at one terminus of a valve stem. The valve unit has a movable valve body and associated hollow valve stem which unseats from a gasket, thereby permitting flow of product into a hollow valve stem (product conduit).

With certain products, e.g. paints, it is desirable that the valve stem be separable from the valve body in order to clean the product conduit should drying and resultant clogging occur. To provide the aforementioned valve stem removal capability, the valve stem, at one end, is molded integral to the valve actuator to thereby permit its separation from the valve body by pulling on the actuator. At the other end the valve stem mates with a movable valve body situated beneath a resilient gasket, the valve stem being passed through a central opening in the resilient gasket. The gasket seals the product discharge orifice in the valve stem when the valve is in a closed position. By

depressing the valve stem, the product orifice in the stem is open to flow of product from the container.

More particularly, the aforedescribed aerosol valve comprises a container closure, commonly called a mounting cup, which is clinched to the container bead. Within and crimped to an upstanding central portion of the mounting cup, commonly called a pedestal, is a valve housing having a resilient gasket disposed atop thereof, which gasket forms a seal between the valve housing and the mounting cup. Disposed within the housing is a reciprocable valve closing/opening member comprising a valve body and valve stem, which body and stem have communicating passages for egress of the pressurized product to a discharge orifice situated in a finger depressible actuator.

The aerosol valve described above is commonly referred to in the aerosol industry as a "female" valve, in contrast to the so called "male" valve wherein the valve stem is molded integral to the valve body. United States Patent Nos. 3,033,473, 3,061,203, 3,074,601 and 3,209,960 describe aerosol valves of the "female" type and United States Patent No. 2,631,814 describes an aerosol valve of the "male" type.

Furthermore, in prior aerosol valves, the product orifice in the valve stem is formed by a radial pin extending laterally through the wall of the valve stem, a so-called "side action" molding operation. The presence of the "side action" pin necessitates the removal of the pin before ejection of the molded part, with a consequent time delay in the molding operation. Moreover, with orifice sizes commonly used in aerosol valves, the "side action" pin often breaks with consequent shutdown of the molding operation.

Additionally, in prior aerosol valves, the central opening of the gasket seals radially against the product orifice in the valve stem. This sealing of the valve stem orifice upon closure of the valve forecloses gravitational return of the product in the hollow valve stem from moving past the valve stem orifice with the often consequent result that residual product in the hollow valve stem drys and clogs the passage in the valve stem.

In U.S. Patent No. 5,027,985, the parent of the present case which is incorporated by reference herein, a "female" aerosol valve is disclosed having a moveable, gasketed valve body-valve stem located within a valve housing. The valve body has at least one upstanding wall defining a recess in the valve body with a slot

extending from the top shoulder of the upstanding wall. The slot provides communication with the interior of the container when the valve is actuated. The valve stem has a longitudinal opening therethrough and a member that frictionally and releasably engages within the valve body recess. The valve stem also has an orifice aligned with the longitudinal opening of the valve stem and which communicates at one end with the slot in the recess of the valve body and at the other end with the orifice in the valve stem. The central opening of the gasket seals the slot defined by the upstanding wall of the valve body when the valve is in a closed position.

It has been found that this configuration is not appropriate for use as a tilt action valve because the stresses inherent in tilt actuation can open the slot in the wall, loosening the valve stem. The valve stem and valve body could then become separated.

The present invention improves upon the design of U.S. Patent No. 5,027,985 and is also adapted for use as a tilt valve.

SUMMARY OF THE INVENTION

The aerosol valve unit of the present invention comprises a mounting cup, a gasket having a central opening, a valve housing, a valve stem and a valve body, wherein the valve

stem and valve body move within the valve housing in response to pressure on the valve stem. The valve body comprises a cylindrical wall defining a recess in the valve body. The cylindrical wall has at least one thin region extending from a top shoulder of the wall, the thin region and the cylindrical wall defining a slot beneath the thin region. The slot communicates with the interior of the container when the valve is actuated.

The valve stem of the present invention comprises an inner cylindrical portion that frictionally and releasably engages within the valve body recess. The valve stem has a longitudinal opening and an orifice aligned with the longitudinal opening of the valve stem. The orifice communicates at one end with the slot in the recess of the valve body and at the other end with the longitudinal opening in the valve stem. The central opening of the gasket seals the slot when the valve is in a closed position.

In another aspect of the present invention, the valve body has a lower portion and the valve body is tapered inwardly toward its lower portion. The valve housing has an upper portion and the valve housing is tapered outward toward the upper portion. The valve body has an annular shoulder portion which engages the gasket when the valve is not actuated,

preventing product from passing over the shoulder, closing the valve. The shoulder can be at least partially disengaged from the gasket by vertical or tilt actuation of an actuator button, allowing product to pass over the portion of the shoulder disengaged from the gasket, into the valve body and valve stem for discharge.

In another aspect of the invention, the valve stem further comprises a lower cylindrical portion with a pair of tangential openings, the lower cylindrical portion positioned within the valve body such that product enters the valve stem through these tangential openings, causing the mechanical break up of the product.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a longitudinal sectional view of the valve of the present invention, in its closed position;

Figure 2 is a longitudinal sectional view of the valve of Figure 1 in an open position;

Figure 3 is a longitudinal sectional view of the valve of Figure 1, opened by tilt activation;

Figure 4 is a longitudinal partial sectional view of the valve body of the present invention;

Figure 5 is a side view of the valve body of the present invention;

Figure 6 is a perspective partial sectional view of the valve body of the Figures 4-5;

Figure 7 is a view along line 7-7 of the valve body of Figure 4;

Figure 8 is a partial sectional view of the valve body-valve stem assembly of the present invention;

Figure 9 is a longitudinal sectional view of the valve stem of the present invention;

Figure 10 is a view along line 10-10 in Figure 9;

Figure 11 is a perspective view of the valve stem of Figure 9; and

Figure 12 is a longitudinal sectional view of another embodiment of the valve body - valve stem assembly of the present invention.

DESCRIPTION OF THE INVENTION

Figure 1 is a longitudinal sectional view of the aerosol valve of the present invention, in a closed position. The mounting cup of the aerosol container, shown partially cut away, is generally designated as 10. Crimped to the mounting cup 10 is a valve housing 12 and a gasket 14. Disposed within the housing 12 is the valve body 16 having a recess 22. Figure 4 is a sectional view of the valve body 16, showing the recess 22. A valve stem 20 is

disposed within the recess 22 of the valve body 16. The valve body is biased toward the gasket 14 by a spring 18. The lower portion 16a of the valve body 16 is adapted to be engaged by the spring 18. The outer wall 16b of the valve body 16 is preferably inwardly tapered toward the lower portion 16a of the valve body 16 while the interior wall 12a of the valve housing 12 preferably flares outward at its top. This provides space allowing for the rotation of the valve body 16 during tilt activation, which is discussed further, below. A conventional dip tube 46 is shown attached to the bottom of the housing 12.

Upstanding cylindrical wall 26, shown in Figures 5-6, defines the upper portion of the recess 22. The top inner edge 26a of the upper cylindrical portion is chamfered to ease insertion of the valve stem 20 into the valve body 16. The upstanding cylindrical wall 26 has a thin rectangular region 21a referred to as a thin skin. The location of the thin skin 21a is shown in phantom in Figure 5. The cross-section of the thin skin 21a is shown in Figure 4; its back portion is shown in Figure 6. The thin skin 21a runs from the top shoulder of the cylindrical wall 26, almost to its bottom. Beneath the thin skin 21a is a slot 21 passing through the cylindrical wall 26. The slot 21 is

defined by the thin skin 21a and the cylindrical wall 26. The slot 21 is shown in phantom in Figure 5. See also Figures 4 and 6. Preferably, there is a second thin skin 21a and slot 21 on the opposite side of the cylindrical wall 26. See Figure 6. More than two slots is not preferred because it can weaken the cylindrical wall 26. These slots 21 allow for the passage of product into the valve body 16, as will be described below. Beneath the slots 21 are grooves 32 in the side wall 22a of the valve body recess 22, shown in Figures 4 and 6, for example. Figure 7 is a top view of the valve body along line 7-7 of Figure 4, with the cylindrical wall 26, thin skins 21a and groove 32 identified.

The upper portion of the tapered valve body ends in an annular shoulder 40 which engages the gasket 14 when the valve is closed, as shown in Figure 1. This shoulder 40 is preferably rounded at its top, as shown in Figure 4, to improve the seal with the gasket 14 when the valve is closed, as shown in Figure 1. Depending from the shoulder 40 is a first annular wall 40a, preferably tapered toward the center of the valve body 16. The first annular wall 40a intersects a second annular wall 40b which is perpendicular to the cylindrical wall 26. See Figure 7. The first and second annular

walls 40a, 40b, and the cylindrical wall 26 form an annular recess 40c which directs product towards the slots 21, as described below.

The valve stem 20 is disposed within the recess 22 of the valve body 16, as shown in Figures 1 and 8, for example. The valve stem 20, as shown in Figure 9, includes an inner cylindrical portion 60 and an outer cylindrical portion 62. A longitudinal opening 63 passes through the valve stem 20. Preferably, a lower cylindrical portion 64 depends from the inner cylindrical portion 60. The lower cylindrical portion 64 of the valve stem 20 has oppositely positioned tangential openings 66. See Figure 11. The cross-sectional views in Figures 1 and 8, for example, go through one of the tangential openings 66. Figure 10 is a bottom view of the valve stem along line 10-10 of Figure 9, showing the tangential openings 66 in the lower cylindrical portion 64.

The bottom of the recess 22 of the valve body 16 preferably includes a circumferential groove 52, as shown in Figures 4 and 8, for example. The lower cylindrical portion 64 of the valve stem is inserted into the circumferential groove 52, forming a swirl chamber 68. The fit between the lower cylindrical portion 64 and circumferential groove 52 forms a tight seal between the valve

body 16 and the valve stem 20. Therefore, product can only enter the swirl chamber 68 through the tangential openings 66. The portion of the bottom of the recess 22 of the valve body 16 within the circumferential groove 52 forms the bottom 50 of the swirl chamber 68. The use of a swirl chamber is preferred for enhanced spray characteristics, particularly with compressed gas propellant, as is described further below. The tangential openings may be about 6 thousandths of an inch wide and 10 thousandths of an inch high. These dimensions may be varied dependent on the product and propellant.

Figure 12 shows another embodiment of the present invention, without the swirl chamber. The valve body 16 is the same except there is no groove 52. The valve stem 20 is the same except there is no lower cylindrical portion 64.

Returning to Figure 8, the valve stem 20 has an orifice 70 above the swirl chamber 68 which, in the preferred embodiment of the invention, acts as a product flow control orifice. Disposing the orifice 70 above the swirl chamber permits product in the valve stem on the discharge side of orifice 70 to back flow into the swirl chamber and thus product is less likely to clog the product passage in the valve stem. Still further, disposing the orifice 70

on the discharge side of the swirl chamber 68 can also create a residue of propellant in the swirl chamber upon closing of the aerosol valve, which residue will assist in purging the valve stem and actuator product passages of residual product to thereby avoid or reduce clogging. The orifice may have a diameter of 13 thousandths of an inch, which can be varied dependent on the product and propellant used.

In the embodiment shown in Figure 12, product entering the bottom of the recess 22 of the valve body 16 will enter the valve stem 20 directly through the orifice 70.

Preferably, the recess 22 of the valve body 16 includes an annular indentation 54. Similarly preferred are a pair of annular protrusions 78 on the valve stem 20 for engaging the annular indentation 54 of the valve body 16, securing the assembled valve body-valve stem together, as shown in Figure 8.

The outer cylindrical portion 62 of the valve stem 20 preferably includes an annular flange 80. The flange prevents excessive displacement of the gasket during actuation. The shape of the annular recess 40c generally conforms to the shape of the flange 80. A recess 75 is formed between the inner and outer cylindrical portions 60, 62 of the valve stem 20. The recess has an annular shoulder 77 which

connects the inner and outer cylindrical portions 60, 62, and against which the arcuate wall 26 bottoms when the valve body 16 and valve stem 20 are in assembled relation. The inner edge 82 of the outer cylindrical portion 62 of the valve stem 20 is tapered to ease insertion into the valve body 26.

An actuator button 85 is mounted on the upper portion of the valve stem 20, as shown in Figure 1. An annular rib or barb 87 is formed on the valve stem 20, which rib 87 anchors the valve stem 20 to the actuator button and facilitates removal of the valve stem 20 from the valve body 16. A tilt button 88 with an inclined surface 88a may also be provided for tilt actuation, as shown in Figure 3. The inclined surface 88a eases engagement and continued actuation in the tilt position during prolonged use. A recess 89 may be provided at the bottom of the tilt button 88 so that the bottom of the button will not interfere with the pedestal of the mounting cup 10 during use.

In the closed position of the aerosol valve, shown in Figure 1, the gasket 14 seals against the annular top shoulder 40 of the valve body 16 and the upstanding cylindrical wall 26 of the valve body 16 to prevent passage of product through the slot 21.

In the open position of the valve, shown in Figure 2, vertical pressure on the actuator button 85 depresses the valve stem 20 and the valve body 16, disengaging the annular shoulder 40 from the gasket 14. The pressurized contents of the container can then pass over the shoulder 40, into the annular recess 40c and through the slots 21. The product proceeds down the grooves 32, through the tangential openings 64 in the lower cylindrical portion 64, into the swirl chamber 68. The product proceeds out of the swirl chamber 68, through the orifice 70, up the valve stem to the discharge orifice 84 of the actuator button 85.

The tangential entrances 66 of the swirl chamber 68 impart a circular motion to the discharging product, and force the two product streams into each other. This causes a mechanical breakup of the product. Particles within the product stream are broken up and dissolved and the product stream is energized. This provides for a finer, drier spray. The use of a swirl chamber is preferred to enhance spray characteristics, particularly if the propellant used is compressed gas. It is believed that satisfactory spray characteristics can be maintained with a compressed gas propellant as the product is dispensed in periodic use, without the use of vapor taps. Vapor taps can

use up the available propellant before the product is fully dispensed.

Operation as a tilt action valve is shown in Figure 3. To actuate the valve, the tilt button 88 is depressed forward and downward. This disengages the front portion of the shoulder 40 from the gasket 14, as the valve body-valve stem rotates forward. Product passes over the shoulder 40, through slot 21 to be discharged, as described above with respect to Figure 2. The tapered shape of the valve body 16 and the flared upper section 12a of the valve housing provides space for the rotational movement of the valve body 16 during tilt actuation.

The container can be packaged as either a conventional or tilt action container. An extra button can be included in the packaging to provide for alternative use. The buttons can be easily changed.

It has been found that in tilt actuation, a portion of the valve stem may engage the pedestal of the mounting cup. See region "A" in Figure 3. Excessive pressure exerted on the button 88 could be transferred through the valve stem 20 to the valve body 16. If the slot 21 runs from the top of the cylindrical wall 26, as in U.S. Patent No. 5,027,985, this force could separate the wall, loosening the valve stem.

Therefore, the design of the '985 patent is not suitable for tilt actuation. The thin skin 21a is added in the present invention to reinforce the cylindrical wall in this region to maintain the tight fit between the valve stem and valve body. Such reinforcement allows for more reliable molding, as well.

The use of the thin skin enables molding of the valve body without the use of "side action" pins. The core pin used in molding the valve body 16 has a pair of extended sections on opposite sides, which decreases the distance between the core pin and the mold cavity. Plastic filling in this region forms the thin skin 21a. Even greater extensions lie beneath the extended sections. These extensions contact the outer wall of the mold cavity, preventing the collection of plastic. The slots are formed in these regions. The thin skin is pliable enough after molding to allow for easy removal of the core pin. Therefore, no "side action" pins are required to form the slots 21. As discussed above in the Background of the Invention, "side action" pins can slow the molding process.

The skin is preferably about 4 thousandths of an inch thick, which allows for easy removal of the core pin and provides sufficient reinforcement during tilt actuation. The

cylindrical wall 26 is approximately 20 thousandths of an inch thick. The slot 21 may be 0.020 inches X 0.020 inches.

In assembling the several valve components, a sub-assembly comprising the valve stem, valve body, spring and gasket is initially made. Such a sub-assembly properly orients and maintains the position of the gasket relative to the valve body, thereby enabling rapid assembly of the sub-assembly and other valve components without risk of dislodging the orientation of the gasket to the other components prior to permanent positioning of the gasket through crimping of the valve to the mounting cup.

The structure in the valve stem-valve body fitment portions that facilitates disposition and positional stabilization of the gasket onto the valve body is best shown in Figure 8. In assembling the valve unit the gasket 14 is passed over the outside surface of valve stem 20 and ultimately seated on the annular shoulder 40 of the valve body 16.

Moreover, the height of the cylindrical wall 26 is preferably greater than the gasket thickness, to prevent the top shoulder of the cylindrical wall 26 from passing beneath the gasket 14 during pressure filling of the container with propellant.

CLAIMS

1. An aerosol valve unit comprising a mounting cup, a gasket having a central opening, a valve housing, a valve stem and a valve body, wherein the valve stem and valve body move within the valve housing in response to forces exerted on the valve stem,

wherein the valve body comprises a main portion having an inner cylindrical wall defining a recess, and an upstanding cylindrical wall connected to the top of the main portion, the upstanding cylindrical wall defining an upper portion of the recess of the valve body and having at least one thin region extending from a top shoulder of the wall, the thin region, the upstanding wall and the main portion of the valve body defining a slot beneath the thin region, which slot communicates with the interior of the container when the valve is actuated;

wherein the valve stem comprises an inner cylindrical portion that frictionally and releasably engages within the valve body recess, the valve stem having a longitudinal opening and an orifice aligned with the longitudinal opening of the valve stem, which orifice communicates at one end with the slot in the recess of the valve body and at the other end with the longitudinal opening in the valve stem; and wherein the

central opening of the gasket seals the slot when the valve is in a closed position.

2. The aerosol valve of claim 1, wherein the thin region is located at the outside diameter of the upstanding wall.

3. The aerosol valve of claim 1, wherein the thin region has a substantially uniform thickness.

4. The aerosol valve of claim 1, and further wherein the upstanding wall of the valve body has a chamfer to ease insertion of the valve stem into the valve body.

5. The aerosol valve of claim 1, wherein the valve stem further comprises an external annular flange on the lower end of the outer cylindrical portion.

6. The aerosol valve of claim 5 and further wherein the annular flange generally conforms in shape to the annular recess in the valve body to form a flow path to the slots in the valve stem.

7. The aerosol valve of claim 1, wherein the recess in the valve body has an internal annular protrusion and the inner cylindrical portion of the valve stem has two external annular notches which engage the annular protrusion of the valve body in assembly.

8. The aerosol valve of claim 1, wherein the valve body has an annular shoulder portion

which engages the gasket when the valve is not actuated, preventing product from passing over the shoulder, closing the valve, and which can be at least partially disengaged from the gasket by vertical or tilt actuation of an actuator button, allowing product to pass over the portion of the shoulder disengaged from the gasket, into the valve body and valve stem for discharge.

9. The aerosol valve of claim 1, wherein the valve stem and valve body move together within the valve housing in response to forces exerted on the valve body.

10. The aerosol valve of claim 1, wherein the connection between the valve body and the valve stem substantially prevents relative movement between them.

11. An aerosol valve unit comprising a mounting cup, a gasket having a central opening, a valve housing, a valve stem with a longitudinal opening, and a valve body, wherein the valve stem and valve body move within the valve housing in response to forces exerted on the valve stem,

wherein the valve body comprises a main portion having an inner cylindrical wall defining a recess, and an upstanding cylindrical wall connected to the top of the main portion, the upstanding cylindrical wall defining an

upper portion of the recess of the valve body and having at least one thin region extending from a top shoulder of the wall, the thin region, the upstanding wall and the main portion of the valve body defining a slot beneath the thin region, which slot communicates with the interior of the container when the valve is actuated;

wherein the main portion of the valve body is tapered inwardly toward its lower end, and wherein the valve housing has a first top inner diameter and a second bottom inner diameter, the first inner diameter being greater than the second inner diameter,

and wherein the valve body has an annular shoulder portion which engages the gasket when the valve is not actuated, preventing product from passing over the shoulder, closing the valve, and which can be at least partially disengaged from the gasket by vertical or tilt actuation of an actuator button, allowing product to pass over the portion of the shoulder disengaged from the gasket, into the valve body and valve stem for discharge.

12. The aerosol valve of claim 11, wherein the valve stem further comprises an external annular flange on the lower end of the outer cylindrical portion which prevents excessive

displacement of the gasket during tilt actuation.

13. The aerosol valve of claim 12, wherein the annular flange generally conforms in shape to the annular recess in the valve body to form a flow path to the slots in the valve stem.

14. The aerosol valve of claim 12, wherein the thin region is located at the outside diameter of the upstanding wall.

15. The aerosol valve of claim 12, wherein between the first inner diameter and the second inner diameter is a tapered transitional region.

16. An aerosol valve unit comprising a mounting cup, a gasket having a central opening, a valve housing, a valve stem with a longitudinal opening, and a valve body, wherein the valve stem and valve body move within the valve housing in response to forces exerted on the valve stem and valve body,
wherein the valve stem comprises a lower cylindrical portion with at least one tangential opening, the lower cylindrical portion positioned within the valve body such that product enters the valve stem through the tangential opening, causing the mechanical break up of the product.

17. The aerosol valve of claim 16, wherein the lower end of the inner cylindrical portion of the valve stem comprises a hollow cylinder

and the tangential opening is in the cylinder.

18. The aerosol valve of claim 16, further comprising two tangential openings in the lower cylindrical portion of the valve stem.

19. The aerosol valve of claim 18, wherein the lower end of the inner cylindrical portion of the valve stem comprises a hollow cylinder and the tangential openings are in the cylinder.

20. The aerosol valve of claim 17, further comprising a plurality of tangential openings evenly spaced around the perimeter of the hollow cylinder.

21. The aerosol valve of claim 19, wherein the recess in the valve body includes an annular groove for receiving the hollow cylinder of the valve stem.

22. The aerosol valve of claim 21, wherein the annular groove and the hollow cylinder form a seal preventing flow of product through the groove.

23. The aerosol valve of claim 21, wherein the connection between the valve body and the valve stem substantially prevents relative movement between the two.

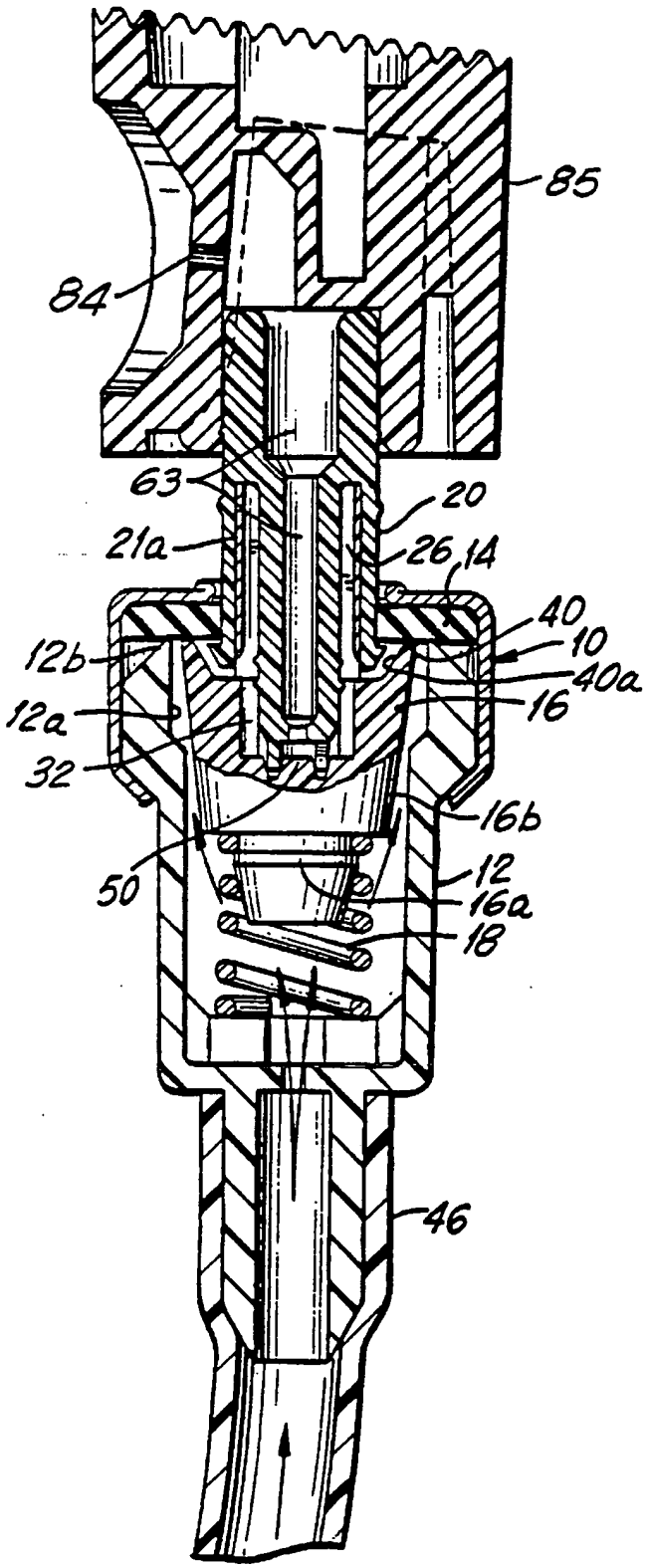

FIG. 1

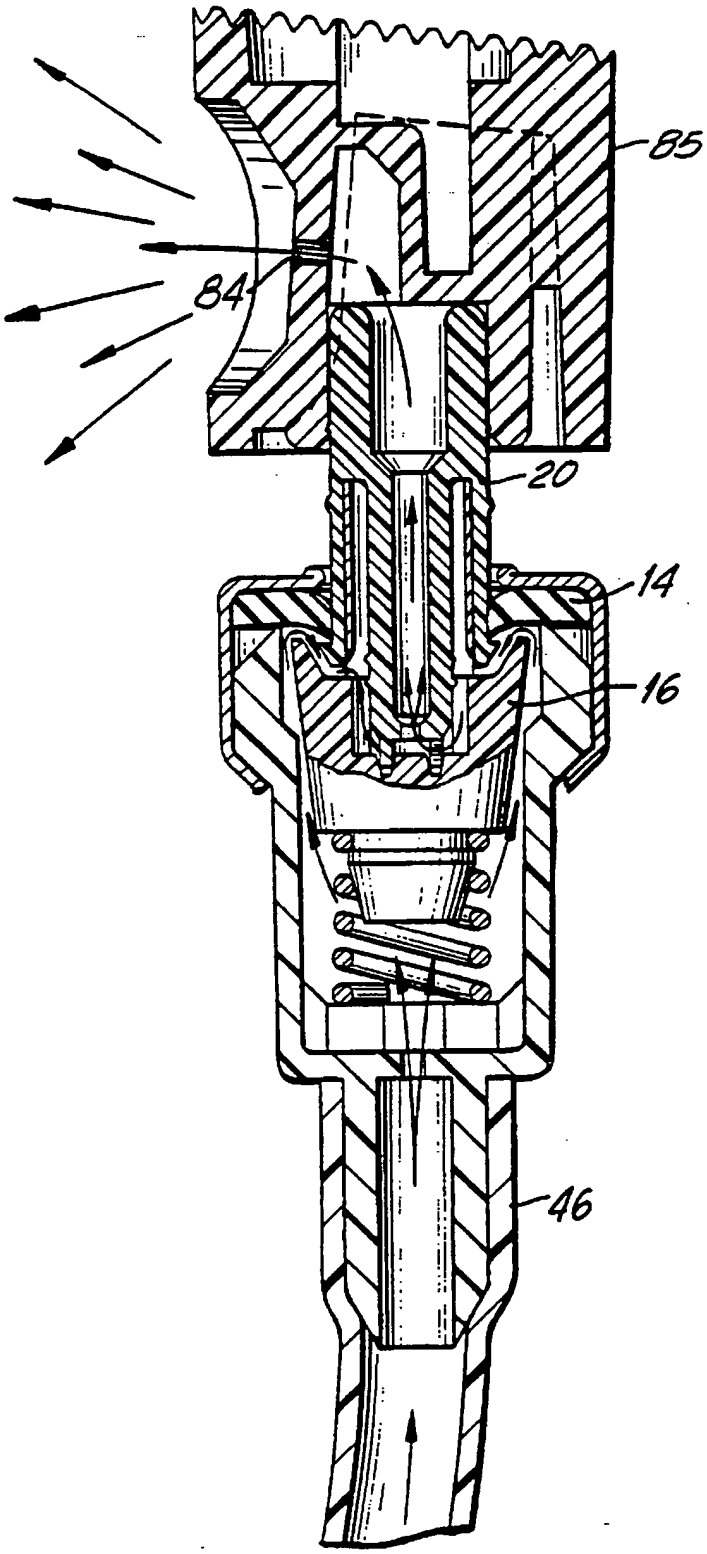

FIG.2

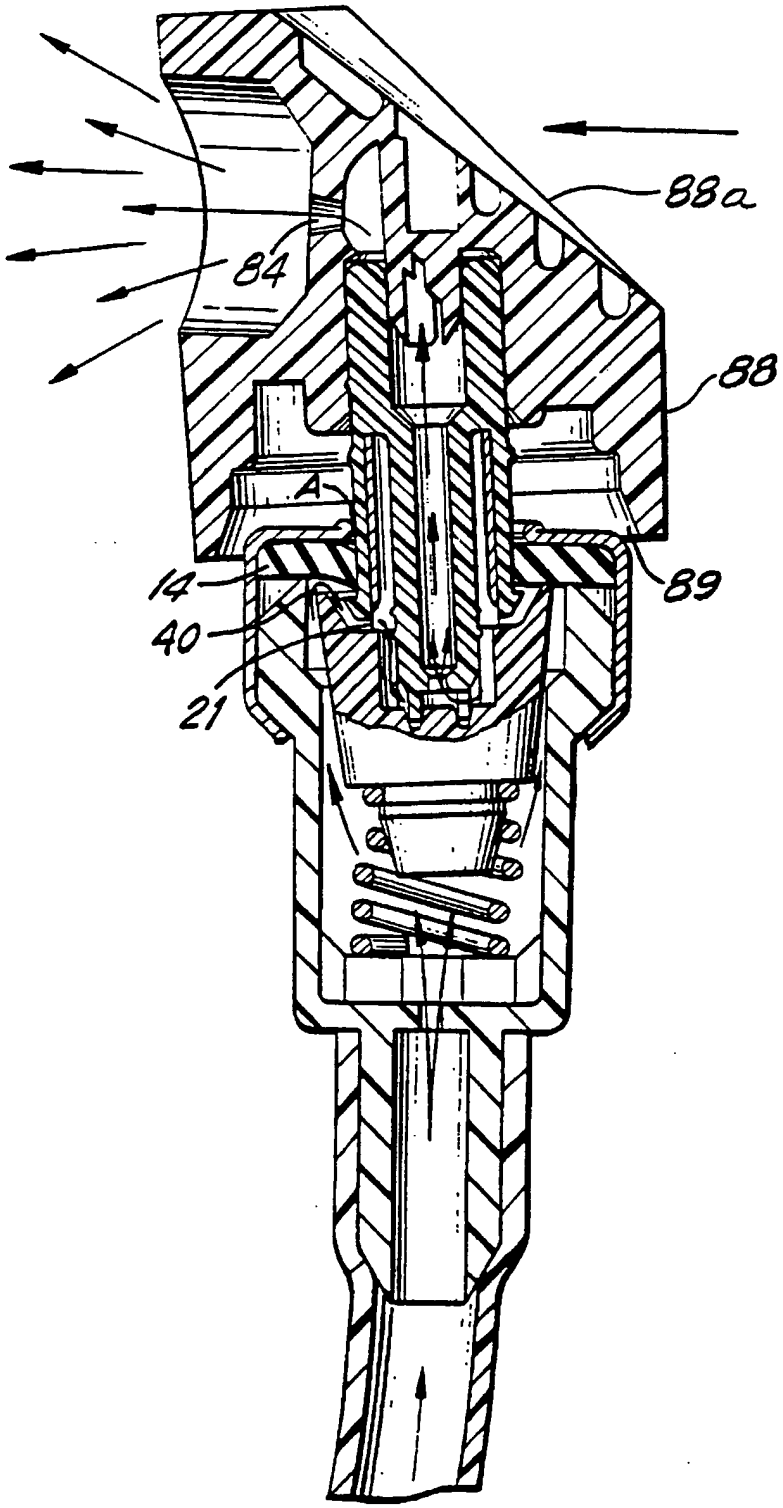

FIG.3

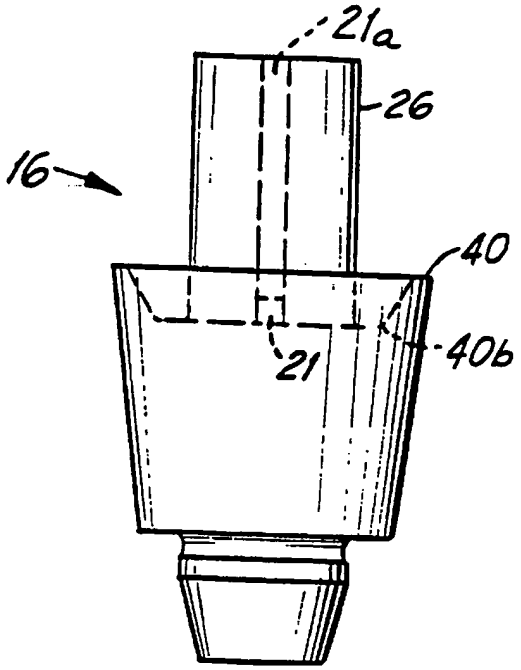

FIG.5

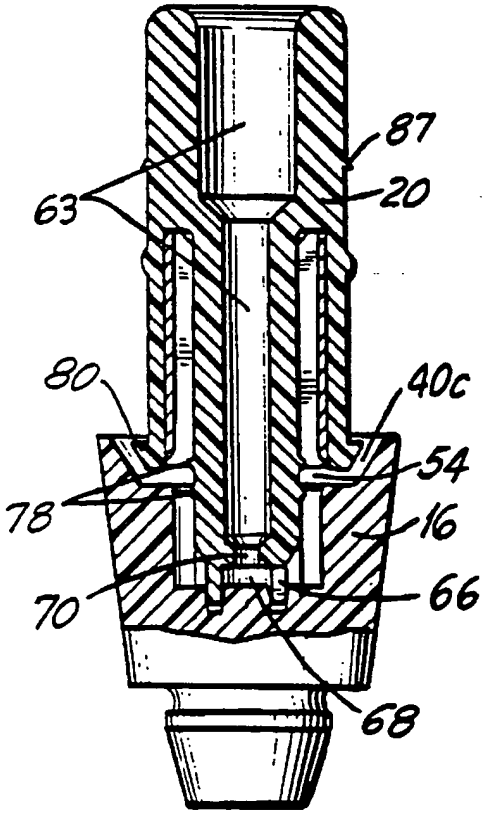

FIG.8

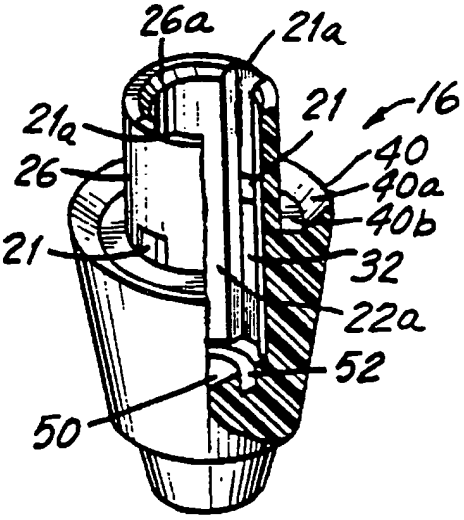

FIG.6

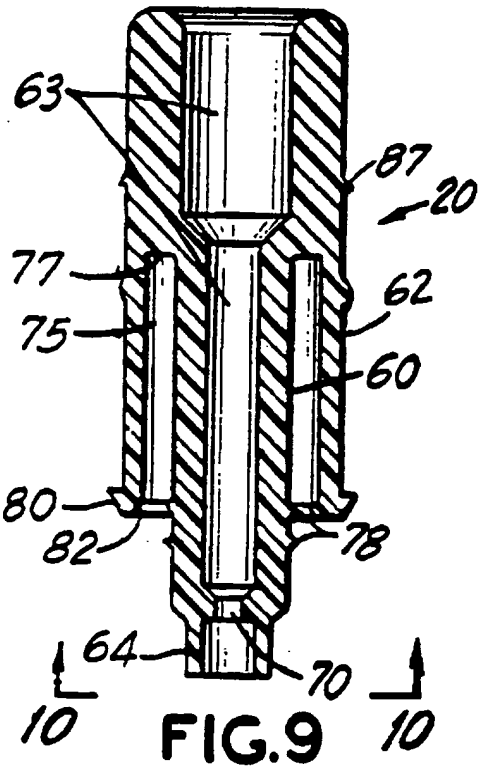

FIG.9

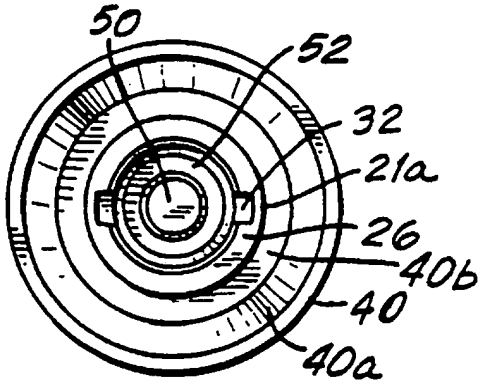

FIG.7

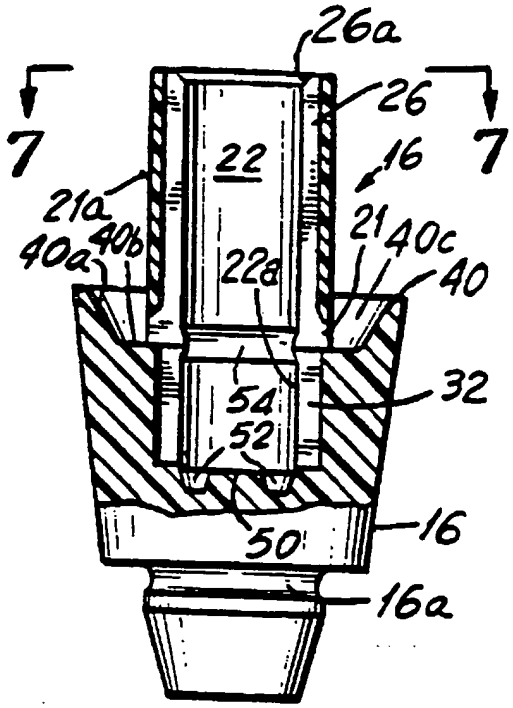

FIG.4

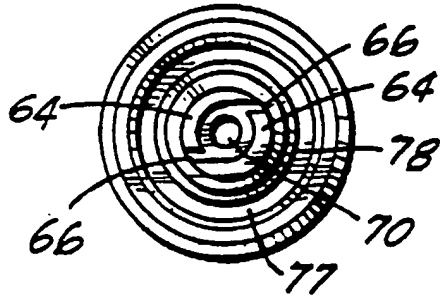

FIG.10

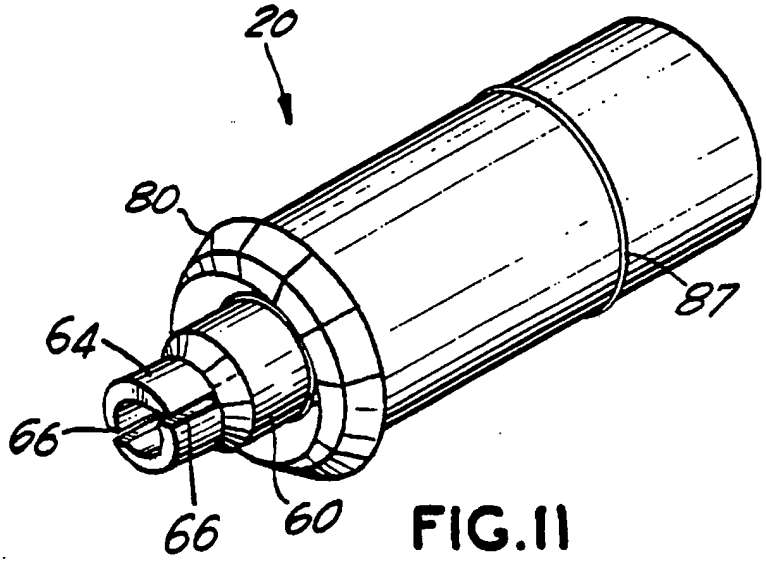

FIG.11

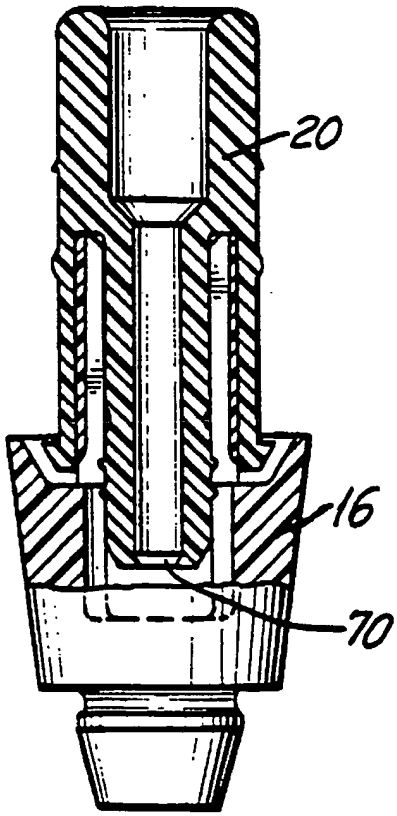

FIG.12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/05586

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B65D 83/00
US CL :222/402.21

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 222/402.1, 402.22, 402.23, 402.24; 239/337, 461, 463, 486; 251/353

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 3,547,405 (Ewald) 15 December 1970, See figures 14 and 15 and column 7 lines 14-39.	16-23
Y	US, A, 3,166,250 (Kappel) 19 January 1965, See figure 5 and column 3 lines 1-16.	16-23
Y	US, A, 3,731,847 (Webster) 08 May 1973, See figure 7 and column 6 lines 54-59.	16-23
A	US, A, 5,037,012 (Langford) 06 August 1991.	
&	US, A, 5,027,985 (Abplanalp) 02 July 1991.	
A	US, A, 3,053,459 (Corsette) 11 September 1962.	

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
02 SEPTEMBER 1992	26 OCT 1992
Name and mailing address of the ISA/ Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer GREGORY L. HUSON
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